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PENSOFT

Found in Brazil again! Expanding the distribution of *Maxillaria aureoglobula* Christenson (Orchidaceae, Maxillariinae) and a key to the species of *Maxillaria* sect. *Rufescens* Christenson from Brazil

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Abstract
The distribution of *Maxillaria aureoglobula* is expanded to northeastern Brazil. This species is probably more geographically widespread than expected, and the new record reported here is a geographical link between the other occurrences of this species in northwestern South America (Colombia and Venezuela) and a recent record from Mato Grosso in the Brazilian Central-West Region. We provide an expanded description of the species, a distribution map, and a key to the Brazilian species of *Maxillaria* sect. *Rufescens*.

Keywords
Amazon forest, Maranhão state, Neotropical region, new record, northeastern Brazil.

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Introduction

Maxillaria aureoglobula Christenson was described based on a specimen from Colombia without precise location (Christenson 2002). It is a member of *Maxillaria* sect. *Rufescens* Christenson, a group of about 30 species distributed mainly throughout northwestern South America, with some species occurring in Mexico, Central America, the Antilles, and Brazil (Arévalo et al. 2015; Schuiteman and Chase 2015; Govaerts et al. 2019).

These species were treated as a separate genus (*Mormolyca* Fenzl) by Blanco et al. (2007), and this classification was followed by Arévalo et al. (2015). However, more recently, a broader circumscription for *Maxillaria* Ruiz & Pav. has been proposed by Schuiteman and Chase (2015). This broader circumscription is followed here because the similarities among smaller genera do not contribute to taxonomic stability. Within *Maxillaria* s.l. species, those included in *M.* sect. *Rufescens* are characterized by having inflorescences produced along the rhizome between older pseudobulbs (Whitten 2009).

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Apart from the widespread *M. rufescens* Lindl. and other species such as *Maxillaria hedwigiae* Hamer & Dodson and *Maxillaria moralesii* Carnevali & J.T. Atwood, which are distributed from Mexico to northern South America, all remaining species of *M.* sect. *Rufescens* have a narrower distribution. *Maxillaria aureoglobula* is known from Brazil, Colombia, and Venezuela, but we exclude its purported occurrence in Costa Rica by Schuiteman and Chase (2015) and Govaerts et al. (2019), since these authors included *Mormolyca fumea* Bogarín & Pupulin as a synonym, a hypothesis rebutted by the phylogenetic study of Arévalo et al. (2015).

Currently, only three species of *Maxillaria* sect. *Rufescens* have been recorded to Brazil: *Maxillaria cleistogama* Brieger & Illg, *M. rufescens* (BFG 2015, 2018) and *M. aureoglobula*. The last species was recently found in the Brazilian state of Mato Grosso, in the Central-West Region (Engels and Ferneda-Rocha 2016). *Maxillaria calimaniana* V.P. Castro, once transferred to *Mormolyca* by Barros and Guimarães (2010), is actually a member of *M.* sect. *Maxillaria* (Schuiteman and Chase 2015).

During recent studies of the Orchidaceae from the state of Maranhão, northeastern Brazil, we found a population of *M. aureoglobula*. This newly found occurrence shows that the species is probably more widespread than expected, and this record is a geographical link between the previously known occurrences of this species in northwestern South America and the recent record by Engels and Ferneda-Rocha (2016)from the Brazilian Central-West. Herein we provide an enlarged, detailed description of this species, a distribution map, and a key to the Brazilian species of *Maxillaria* sect. *Rufescens*.

Methods

The study was carried out in the state of Maranhão (northeastern Brazil). The fieldwork was undertaken in March 2019 at the Sete Irmãos farm in the municipality of Cândido Mendes (Fig. 1). This region is part of the Belem Endemism Center (Amazon Forest), an area with high species richness, but is also a region severely threatened by deforestation (Almeida and Vieira 2010; Martins and Oliveira 2011; Celentano et al. 2018).The climate in the area, according to the Köppen classification, is of the type Am (Alvares et al. 2013), with average annual temperatures between 26 °C and 27 °C and annual rainfall between 2,300 and 2,500 mm. The rainy season extends from January to June and the less rainy period from July to December (NuGeo 2016). The farm occupies approximately 7,000 ha of which about 3,000 ha preserve a fragment of Amazon Forest (Pluvial Forest) traversed by the Macaxeira River and other small stream tributaries of the Maracaçume River. This property supports one of the largest forest fragments with primary Amazonian vegetation in the state (Koch and Araújo-Silva 2014; Celentano et al. 2017).

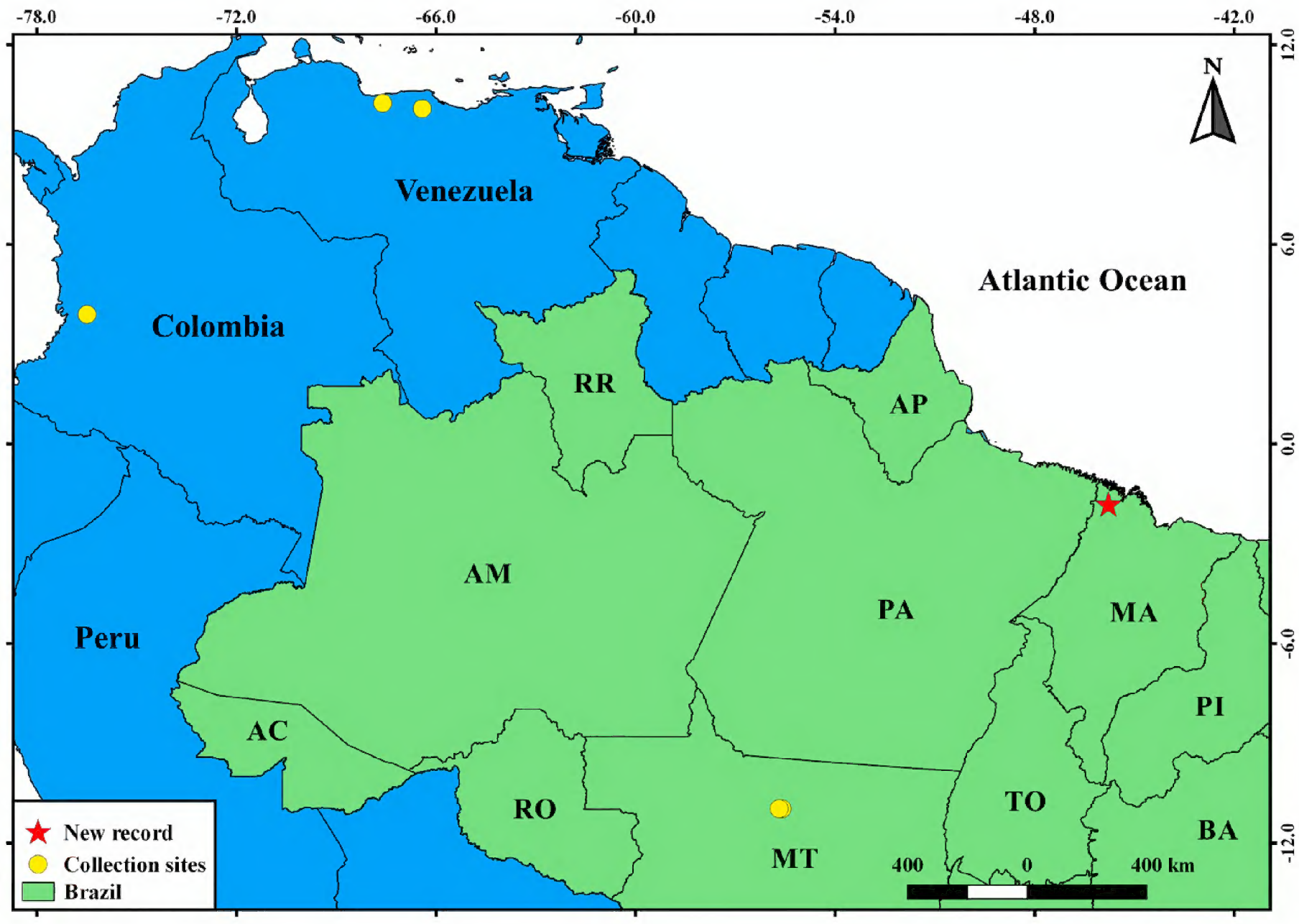

Figure 1. Collection sites of *Maxillaria aureoglobula* Christenson in South America, highlighting the location of the new record in the state of Maranhão, Brazil.

The species was photographed with a digital camera, and specimens were collected according to the usual procedures (Fidalgo and Bononi 1989). The voucher was incorporated in the collection of the MAR herbarium (Thiers 2019). For species identification and description, we used the relevant literature for *M.* sect. *Rufescens* (Illg 1977; Christenson 2002; Bogarín and Pupulin 2010; Krahl et al. 2014; Arévalo et al. 2015; Engels and Ferneda-Rocha 2016; Marcusso et al. 2018). The names of the authors and abbreviations follow Brummitt and Powell (1992). The areas of known occurrence of *M. aureoglobula* were plotted in a map prepared with QGIS 2.16.3 (QGIS Development Team 2019) and used the WGS84 geodetic datum. Except for the specimens collected by Engels in Brazil (Engels and Ferneda-Rocha 2016), no other known specimen of *M. aureoglobula* was georeferenced. Here, to create the map, we used the information of localities available in the protologue (Christenson 2002) and other literature (Dunsterville and Garay 1961; Sauleda 2016), applying online gazetteers. Figures of specimens were edited using Adobe® Photoshop® CS5 Extended 12.0 (2012).

Results

Maxillaria aureoglobula Christenson, Orchids (West Palm Beach) 71: 125 (2002). ≡ *Mormolyca aureoglobula* (Christenson) M.A.Blanco, Lankesteriana 7: 531 (2007). ≡ *Xanthoxerampellia aureoglobula* (Christenson) Szlach. and Sitko, Biodiversity Research and Conservation 25: 37 (2012).

Type. Colombia, without precise location, s.d., *Hort. Orquídeas del Valle s.n.* (holotype: **CUVC**).

Figure 2A–D

New record. BRAZIL – Maranhão • *A.W.C. Ferreira 100* (MAR 11538); Cândido Mendes, Fazenda Sete Irmãos, Igarapé Cumaruzal, 01°50′50″S, 045°46′10″W; 09.III. 2019, fl.

Additional material examined. BRAZIL – Mato Grosso • *M.E. Engels 3300* (HERBAM, MBM); Itaúba, FLORA rescue from UHE Colíder; 10°57′55″S, 055°41′17″W; 02.IX.2014, fr. • *M.E. Engels 3085* (TANG – spirit collection); 10°58′00″S, 055°36′00″W, 16.IV.2015, fl.

Phenology. Flowering from September to May. In Brazil, it was found flowering from March to May, fruiting in September.

Description. Epiphytic herbs, cespitose. **Roots** ca 1 mm in diameter, 3.0–10.0 cm long, white, terete, tangled. **Rhizomes** 2–3 mm in diameter, 0.5–1.5 cm between pseudobulbs, terete. **Pseudobulb** 2.5–5.5 × 0.8–2 cm, 0.4–0.6 cm thick, apically unifoliate, green, ellipsoid to long-ellipsoid, laterally flattened, heteroblastic. **Leaves** 7.0–23.1 × 1.2–3.0 cm, green, lanceolate, narrow-lanceolate, or oblong, sessile, conduplicate, subcoriaceous. **Inflorescence** 1-flowered, erect, produced from the rhizome between the pseudobulbs; peduncle 1.8–3.1 × 0.1 cm; terete, pale green, peduncle bracts 0.3–1 × 0.2–0.6 cm, oblanceolate, acute to obtuse, pale green to brown; floral bract 0.8–1.1 × 0.6 cm, invaginated, oblanceolate, acute, bright green to brownish. **Flower** yellow, resupinate; ovary and pedicel 1.7–2.4 × 0.15 cm, green, terete, 3-sulcate; **dorsal sepal** ca 1.1–1.4 × 0.5–0.8 cm, elliptical to elliptical-lanceolate, obtuse, yellow; **lateral sepals** 1.1–1.3 × 0.5–0.8 cm, lanceolate, acute-obtuse, yellow; **petals** 0.9–1.1 × 0.4–0.6 cm, elliptical to elliptical-lanceolate, acute-obtuse, yellow; **lip** 1.0–1.2 × 0.6 cm, longitudinal keel soft, adhered to the base of the column, 3-lobed, yellow with reddish brown spots, lateral lobes 0.4–0.5 × 0.1–0.15 cm, close to the basal portion of the lip, elliptical to obliquely triangular, apex obtuse to acute, midlobe ca 4.0–6.0 × 2.0–3.0 mm, oblong, subtruncate to rounded, callus 2.0 × 1.0 mm, linear-elliptical, red from the base of the lip to a little less than half of its length; **column** 0.75–1.1 × 0.2 cm subtriangular, arcuate, yellow; **anther cap** 2.0 × 1.0 mm, subglobose, yellow; **pollinia** four, yellow, in two subequal pairs, 1.0 × 1.0 mm. **Fruit** immature, 3.6–4.0 × 0.5–0.7 cm, elliptical, green.

Discussion

The new record of *M. aureoglobula* from Maranhão highlights the importance for conservation of the few remnants of the Amazon forest in the state. Ferreira et al. (2017) also found two new records of orchid species in western Maranhão, pointing out the urgent need for taxonomic inventories in this peripheral area of the Amazon.

The previous collections of the species in Itaúba (Mato Grosso, Brazil; Engels and Ferneda-Rocha 2016) are approximately 1,488 km away from the new record, which is about 2,761 km from the municipalities of Maracay and Guatopo, Venezuela (Dunsterville and Garay 1961) and around 3,474 km away from near Calima Lake, Darien, Colombia (Sauleda 2016) (Fig. 1; Table A1). The few known specimens suggest that despite the relatively wide geographic distribution of *M. aureoglobula*, this species seems to be uncommon.

Its rareness and its ecology, growing at the top of tall trees, suggest that *M. aureoglobula* might be found in other places in Brazil or in other countries. For example, Miranda (1996) presented a photograph of a specimen from the state of Rondônia (BR 364 road, municipality of Jaru), identified as *M. unguiculata* Schltr., but which appears to be *M. aureoglobula*.

The area where *M. aureoglobula* was collected in Maranhão is locally classified as "gallery forest"; *M. aureoglobula* was found growing on *Lecythis pisonis* Cambess. (Lecythidaceae) about 20 m above the ground, where it was coexisting in the canopy of this tree with *Camaridium ochroleucum* Lindl. and *Prosthechea fragans* (Sw.) W.E.Higgins.

Among the three species of *M.* sect. *Rufescens* from Brazil, *M. rufescens* is easily distinguished by the

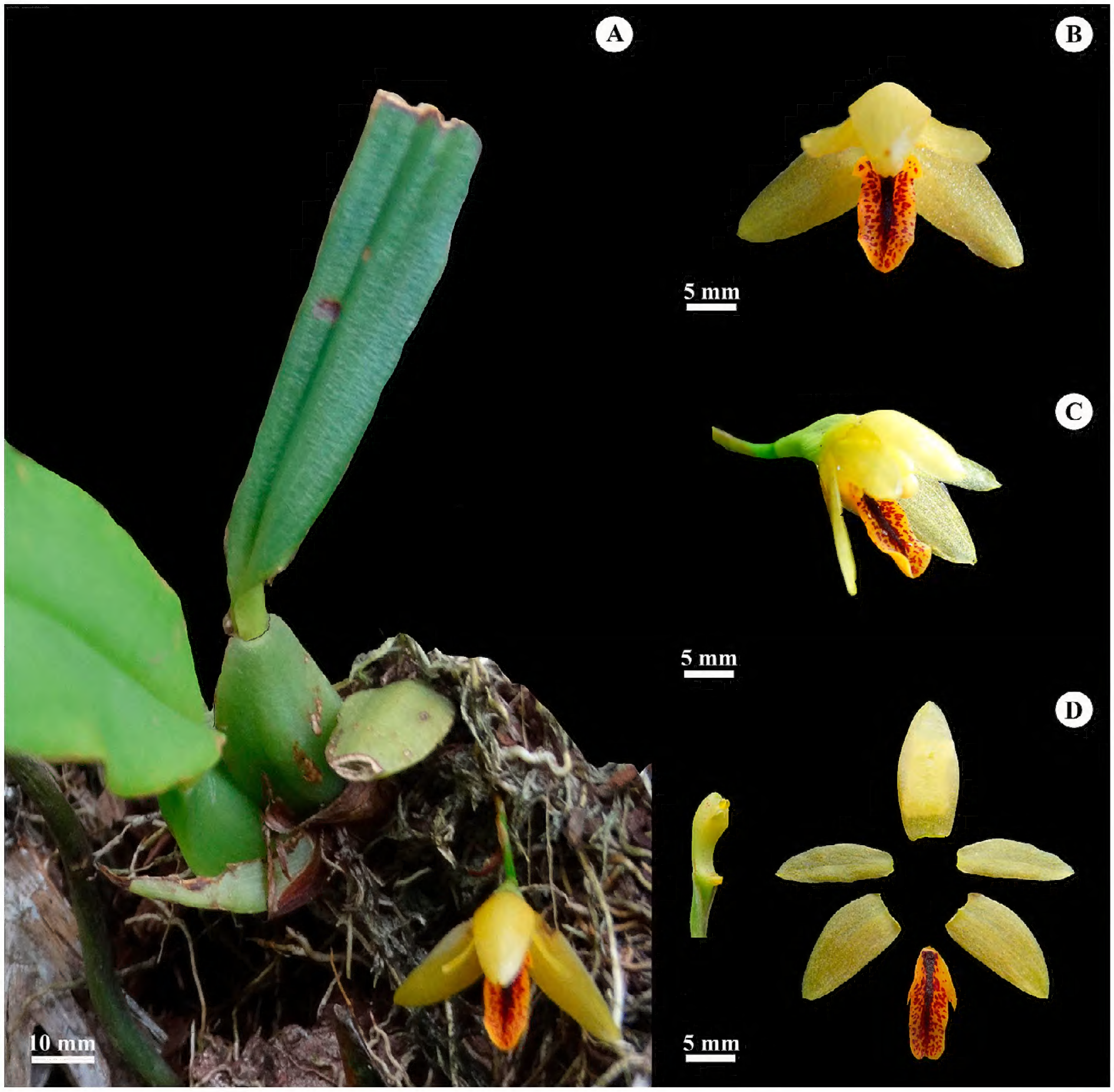

Figure 2. *Maxillaria aureoglobula* Christenson (MAR 11538). **A.** Flower in frontal view. **B.** Flower in lateral view. **C.** Dissected perianth. **D.** Habit. (Photographs by AWCF.)

length of the perianth (>2.0 cm vs <1.5 cm long). Specimens of *M. cleistogama* are often cleistogamous, but not always (see photograph of an open flower in Marcusso et al. 2018); its open flowers are distinguished from *M. aureoglobula* by the sepals and petals oblanceolate and midlobe of the lip as long as wide to slightly longer than wide (vs sepals and petals elliptical to lanceolate and midlobe of the lip twice longer than wide). An identification key to the Brazilian species of the section is provided below.

Maxillaria acutifolia Lindl., a species described from the coast of Guyana, is the most similar and probably closely related. However, the form of the lateral lobes of the lip (smaller and arched vs larger and not arched) and apex of the midlobe of the lip (emarginate vs rounded and truncate) are distinct. This species has been included as a synonym of *M. rufescens* by some authors (Dodson and Dodson 1980; Jørgensen 2014; BFG 2015); however, it is clearly a distinct species with a confirmed distribution from Mexico to the coast of Guyana and Venezuela (Schuiteman and Chase 2015).

Other species, such as *M. moralesii* Carnevali & J.T. Atwood (Mexico to Panama) and *M. chacoensis* Dodson (Bolivia, Peru, and Ecuador) (Govaerts et al. 2019), are similar, and unlike *M. acutifolia*, distinguishing these two species from *M. aureoglobula* is difficult. Until now, the best means to do this is by comparing the geographic distribution and habitat, since the areas where the types of *M. chacoensis* (Ecuador) and *M. moralesii* (Costa Rica) were collected are at higher elevations (800–1500 m). A taxonomic revision of this group is still needed to address these issues.

Identification key to the species of ***Maxillaria*** sect. ***Rufescens*** in Brazil

1 Perianth >2.0 cm long ..... *M. rufescens*
1′ Perianth <1.5 cm long 2

2 Sepals and petals oblanceolate; midlobe of the lip as long as wide to slightly longer than wide, usually cleistogamous ..... *M. cleistogama*
2′ Sepals and petals elliptic to lanceolate; midlobe of the lip twice longer than wide, never cleistogamous ..... *M. aureoglobula*

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Authors' Contributions

AWCF collected and photographed the plant. AWCF and MEE identified and described the specimen. MSO prepared the images. AWCF, MSO, MEE, and EP revised herbarium collections and wrote the text.

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Appendix

Table A1. Collection records of *Maxillaria aureoglobula* Christenson in South America used for producing of the distributional map. Herbaria acronyms follow Thiers (2019).

Country/state/locality	Latitude	Longitude	Herbarium/source
Brazil, Maranhão, Cândido Mendes, Sete Irmãos Farm	01°50′50″S	045°46′10″W	MAR
Brazil, Mato Grosso, Itaúba, Colíder Hydroelectric	10°57′55″S 10°58′00″S	055°41′17″W 055°36′00″W	HERBAM, MBM
Colombia, Darien	03°53′40″N	076°29′37″W	CUVC
Venezuela, Municipality Maracay	10°14′54″N	067°36′19″W	Dunsterville and Garay 1961
Venezuela, Municipality Guatopo	10°04′59″N	066°24′59″W	Dunsterville and Garay 1961